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STANDARDS DURING TIMES OF CHANGE: AEROSPACE STRATEGIES FOR KEEPING STANDARDS AND BUSINESS LINKED

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Today, as the aerospace industry gears up to celebrate the 100th anniversary of powered flight, the world is a far more complex and technologically driven place than the one encountered by Wilber and Orville Wright. We went from Kitty Hawk to the moon in 66 years. Now, significant change is occurring in ever increasingly shorter time spans. The aerospace industry has become a global business, not just from the standpoint of those that use our products, but also as designers and producers of these products. And the world of standards plays a significant role in supporting this change. Like the business of building aerospace products, the business of standards must adapt to meet the demands of a changing environment. To do this, aerospace companies continue to evolve their strategies for the development, management, and use of their standards to successfully respond to and manage change.

Standards Strategies to Drive Quality Through a Complex Supply Chain

ISO 9000 changed the way the world looked at managing quality. But to implement ISO 9000, the aerospace industry required a new strategy for developing an international quality system and for implementing the

standards required to successfully drive those changes down through one of the largest and most complex supply chains of any industry. The Boeing Company for example, has over 15,000 suppliers in over 80 countries. And those suppliers have suppliers. How the aerospace industry has addressed the need for global quality standards is becoming quite a success story.

Given that the members of the aerospace industry share the same pool of customers and suppliers, it only made sense to standardize on a single aerospace quality management system. The industry needed to get together and decide how best to implement the requirements of ISO 9000. Additionally, they needed to develop supplemental quality standards to accommodate the aerospace unique requirements demanded for the production of supremely complex, highly reliable products expected to perform over a long period of time (commercial aircraft have an expected life span of 50 years).

This challenge meant not only creating standards that met the needs of the aerospace industry but also creating a new standards system in which to develop,

promote, and implement these new quality standards. Boeing and other industry leaders had very specific requirements for the standards system needed to support a global aerospace quality system. It needed to be international in scope and membership. Industry wanted direct participation and wanted to include aerospace regulatory agencies and customers. It was critical that the system had a fast, responsive standards development cycle. And, most importantly, that the results were a single globally used and recognized standard.

While the industry was reluctant to create a new standards developing organization, there was no existing venue that met all the above requirements. So the industry went to three of the major aerospace standards developers and requested a special alliance to support a whole new standardization model. The result was the International Aerospace Quality Group (IAQG). The IAQG is a cooperative organization of the global aerospace industry. It is not a legal entity, but rather a dynamic cooperation based on trust between international aerospace companies for the purpose of establishing and maintaining

standards and initiatives to make significant improvements in quality performance and reductions in cost throughout the aerospace value stream. To facilitate its work and to take advantage of existing infrastructures, the IAQG is divided into three sectors: Europe, the Americas, and Asia; and is sponsored by three aerospace standards organizations: the European Association of Aerospace Industries (AECMA), the Society of Automotive Engineers (SAE), and the Society of Japanese Aerospace Companies (SJAC) (Figure 1).

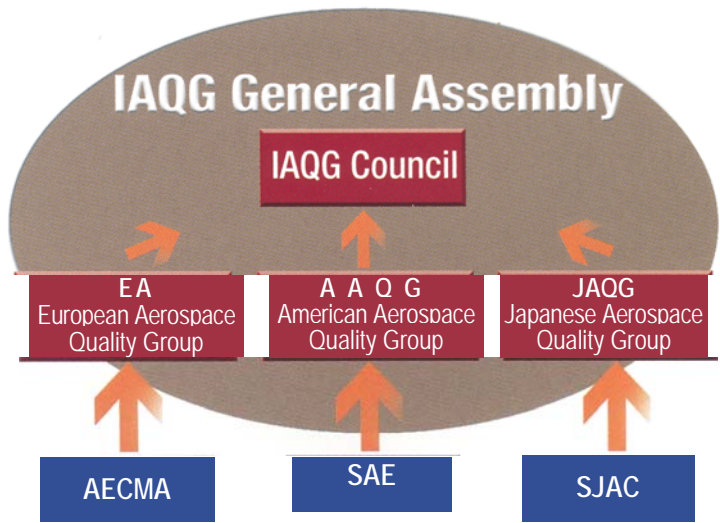
additional requirements for an aerospace quality management system which must be addressed when implementing an ISO 9001:2000-based quality system. And each sector has then authorized translations by other standards developing organizations to provide language specific standards across the international community.

Developing a single aerospace quality system in just over a year, and follow-on quality standards in 9-12 months is quite an achievement. But the real

key to success. This is the first time in the aerospace industry that signed commitments from upper management were required prior to participation in the development of international standards. What's more, implementation statistics for each member company are tracked at every IAQG meeting. More than 60 percent of IAQG members have implemented the AS/prEN/SJAC 9100 standard internally and are flowing it down to their suppliers. Most members will require suppliers to comply by December 2003, consistent with the transition from the old ISO 9001 to the new version.

FIGURE 1

International Aerospace Quality Group



This creative cooperative includes 47 of the largest members of the aerospace industry. The three regional sectors coordinate requirements for quality related standards and the results are then harmonized by the IAQG. The globally harmonized standard is then published simultaneously by each of the three sponsoring organizations. Thus, we have AS/prEN/SJAC 9100 which defines the

power of the IAQG comes from the commitment of the member companies. There is a signed agreement of intent to implement the resulting IAQG standards by the upper management of all involved companies prior to the development of the standard. Since a standard only has value if it is used, the commitment to implement from the highest levels of the companies involved is the

As AS/prEN/SJAC 9100 becomes established within the industry, the standard's benefits are becoming quite apparent. There is now a common industry voice to suppliers and a consistent set of expectations. The standard is non-prescriptive so it allows suppliers to implement best practices. There is a consistency in verification methodology and audit results can now be shared. The industry has developed a cooperative oversight process to assure the integrity of "other party" audits. Suppliers report a reduction in verification audits and, as a direct result, suppliers' customers are seeing a reduction in oversight costs and an improvement in supplier performance.

Aerospace manufacturers are also beginning to reap the benefits of this standards strategy. Industry leaders are projecting significant cost savings and reductions in variability through the implementation of a globally harmonized quality system. This is the power of a strategy that brings together an

entire community, forges alliances of standards developers, and solicits corporate commitment to implement standards to improve business.

Strategies for Managing Standards in a Virtual Product Enterprise

Aerospace products are huge, complex platforms requiring years to develop and billions of dollars of investments. Gone are the days when a single company will undertake to bring out a new aircraft (military or commercial) alone. Today's new products are being developed more and more by teams, not by individual companies, or even by individual countries. The result of this teaming is the creation of the virtual product enterprise—partners, electronically linked together in a shared collaborative environment to support the joint design and development of a specific product. This virtual product enterprise exists solely to produce a specific product, and companies teamed together on one product can be *fierce* competitors for another. The ability to collaborate has become the key to the success of an enterprise. And just as standards are vital to supporting the business of an individual company, they are critical to the business of these product partnerships. This means developing new strategies for managing standards in a virtual product enterprise.

In the past, negotiations between companies to establish a partnering relationship centered on things like work splits, cost sharing, patent rights, and final authority over design decisions. Today, standards are included as an essential part of the teaming arrangement. There is a recognition that the standards chosen during the design phase of a prod-

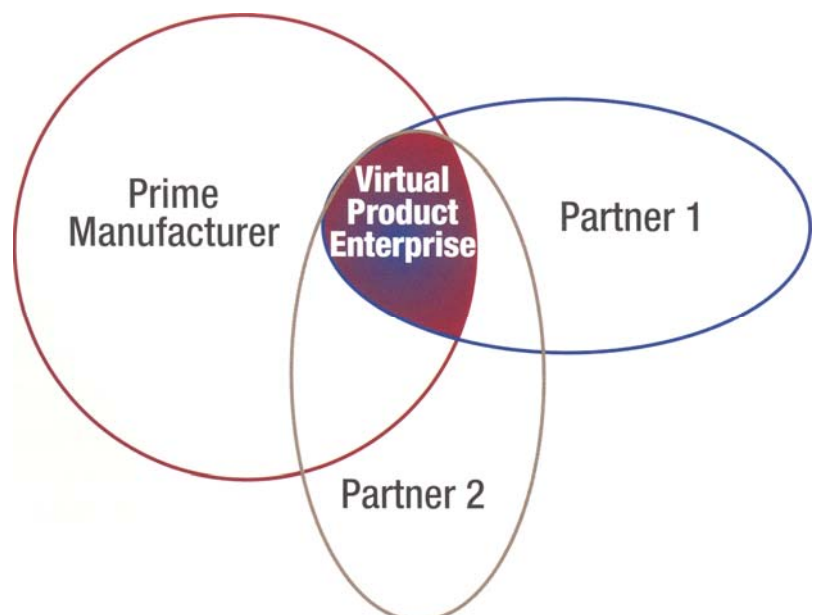
uct and the system established for managing them will have significant cost implications which extend far beyond engineering and throughout the entire life cycle and support of the product. Because standards are called out on the product drawings and are an integral part of the Product Definition, which is what the Federal Aviation Administration (FAA) or the Department of Defense (DoD) certifies, each teaming arrangement must include a strategy for the management of standards data in a shared design environment which protects the data integrity, ensures configuration management, and results in optimum product quality. Such a strategy involves a number of decisions.

The first issue to be resolved is one of standards selection in a collaborative design environment. Which company has selection authority? Does the Prime

Manufacturer have ultimate say over the choice of a standard or does each partner retain the right to choose the standards governing their part of the design? This issue feeds into the question of "Yours, Mine, Ours, or Theirs." The aerospace industry still relies heavily on company unique standards for parts, materials, and engineering processes. Will the Prime Manufacturer (the company ultimately responsible for the product definition and the holder of the Type Design Certificate) allow other companies' standards to be called out on the Prime's drawings? Or will all standards be converted into the Prime's standards, either directly or by cover sheeting? Another option is to create team specifications for use only on the specific product. This then brings up the issue of numbering. If company standards are cover-sheeted or converted into team specifications, how will they

FIGURE 2

The Standards Management Strategy for the Virtual Product Enterprise has a direct impact on business and the bottom line.



be numbered? Part numbers and material identifications are usually based on the standard's number. If the standard is converted to a team standard or cover-sheeted with a different number, there is now a disconnect between the standard and the part or material it defines in the shared collaboration environment.

Which selection strategy is chosen will have multiple maintenance implications. Configuration management—controlling and tracking all changes to the product definition and manufacturing process—is absolutely critical to the aerospace industry. If a standard called out as part of a product definition is changed in such a way that it impacts the product definition, the Type Certificate or Production Certificate for that product is jeopardized. In a worse case scenario, these Certificates can be revoked, production halted, and even all models of a product grounded. Imagine all Airbus 340s or Boeing 747s grounded because a critical standard used to build the plane was changed so it was no longer suitable for that design and the standards management system in place never caught the change. Ensuring a comprehensive standards management strategy is paramount.

So, if the Prime allows a partner's standards to be called out on an electronic product definition, what happens when the partner decides to revise that standard? If the standards called out on a product drawing—which is now a computer aided design model—are frozen at that revision level, then the opportunity is lost to benefit from any process improvements or best practices which are incorporated in later revisions of the standard. However, if the standard is not frozen, then what reporting mechanisms need to be put into place to ensure that the Prime and any other impacted partners, suppliers, etc. are notified of revisions? What approval or buyoff system needs to be established to ensure that the revised standard still meets the product requirements and what are the alternatives if a partner wants to change a company standard even though it won't then meet a particular program's needs? Of course, much of this can be avoided if an industry standard is used,

since all partners have equal visibility and say in its revision. However, this choice carries its own implications in terms of the program's ability to codify proprietary materials or processes, or to quickly revise a standard to implement a change or address a production problem.

A final issue to be addressed by a standards strategy is access and distribution of the standards. Since design is now carried out in an electronic environment, using CAD/CAM tools and linking intranets over the web, how are the standards integrated into this? Are all the various standards, including a partner's company standards, placed on the Prime's web or does every partner get copies of all the standards to house internally? Is a separate Virtual Product Enterprise web environment created and all standards placed there? If these are company standards, are they copies of the originals back on the company sites (which then brings up the maintenance issue)? And how will these standards be passed down the supply chain?

As complex an undertaking as building an airplane or space vehicle is, managing the standards behind the product is every bit as challenging. Each of the issues inherent in a standards strategy for partnering involves choices that carry with them pros, cons, and implications for other issues, which must be carefully weighed as part of the whole strategy. How well a company designs a standards strategy for a Virtual Product Enterprise plays a key role in the success, and profitability, of the resulting product. Having a well thought-out and defined standards strategy is critical to a successful design partnership and to avoiding a host of problems throughout the production and support life cycle of the product.

Strategies for Shifting the Standards Landscape with the Business Landscape

The aerospace industry is learning how to design, build, and market its products in ways different from ever before. It's also implementing change at a rate much faster than ever imagined. Information technology is now fundamental to all our business processes, it's a key component of our products, and it controls the environment in which our products operate. And to ensure

that these new IT products and processes can be successfully—and profitably—integrated into aerospace products, the industry is having to evolve its strategies for standards development to include these new areas.

Information technology is taking the industry into areas that are not the domain of aerospace alone. Where once, a good portion of the technology used to build our products was ours to control, we're now utilizing and incorporating technologies which are used far beyond the aerospace industry, and what's more, were not even originally intended for use by aerospace. Information technologies, and the standards used to define them, are shared by a broad range of industries and products. Company specifications are no longer always an option. Participation in IT standards developing organizations is the fastest growing area of aerospace standards work. To ensure interoperability and interconnectivity, you must have standards. And moving outside aerospace dominated standards bodies carries with it the demand for new standards development skills. Participants must be able to articulate aerospace unique requirements in such a way that non-aerospace members will not only understand them, but also be willing to accommodate them.

In-flight entertainment systems are an example of an area where the aerospace industry is not leading the technology, but rather is trying to take advantage of all the innovations in personal entertainment equipment. But to do this, the industry has to drive some very special needs into the standards for these products and this technology. Personal DVDs, video games, rapid improvements in liquid crystal displays for small TVs are all happening outside of the aerospace industry. In the past, the entertainment system was hard-wired into the plane. This ensured that all components were controlled and did not interfere with the operation of flight critical electronics. However, that meant ripping everything out to install an upgraded system. The aerospace industry has had to develop new standards for interconnectivity—connectors, wires, power systems—to allow airlines the ability to choose their entertainment

systems and upgrade them when they wish without radically impacting cost or the functionality and integrity of the aircraft itself.

Computer modeling and simulation are two more areas aerospace is increasingly using. But it will take the development of a whole range of industry standards to move these technologies out of the labs and "special project status" and into the production world. Standards strategies are targeting key areas that will pull these systems together and allow them to operate in huge distributed networks.

Information technology will improve the convenience of air travel for the passenger. The aerospace industry is now working with the banking industry to develop standards for smart cards containing biometric data which would allow a trusted traveler to be identified and pre-cleared for customs, check-in and increased security. Again, a strategy involving a technology, and an alliance, not thought of ten years ago.

And finally, there is the area of global connectivity—allowing passengers to stay connected even from 35,000 ft. Systems like Connexion by Boeing are being installed in aircraft to allow passengers real-time connection to the Internet and e-mail. And to support this new demand by the flying public, aerospace companies are populating the standards forums dealing with the Internet and sitting side-by-side with members of other industries, such as automotive, who want the same for their customers.

Information technology and systems integration capability are opening the way for the industry to dramatically change the environment in which our products operate. Air traffic management systems are moving to rapidly incorporate advances in IT. Global positioning satellite systems and terrain mapping databases will allow aircraft to operate with more efficient routings and much more safely.

And probably the best demonstration of the impact of information technology is for integrated defense—where aircraft, spacecraft, unmanned vehicles, and

ground equipment are all linked together to provide our defense systems the ultimate in information superiority. Data from surface, air and space systems will be merged and transmitted throughout an information network in a huge integrated system of systems. And it will be standards that ensure that every element in this system is able to process, send and receive information. Aerospace companies are strategically placing their experts at the tables to ensure that standards for the interoperability and interconnectivity of these technologies are developed.

Information technology has forced the aerospace industry to change its business models—its products, processes, in sum, its vision. It will change the way we control airplanes, the way we move people through airports, and how we keep them connected. And as information technology continues to radically change the world and our industry, it is imperative that we have the foresight and the strategic planning to ensure that we are a part of defining the standards that will enable these new technologies.

The key for an aerospace manufacturer in ensuring cost-effective adoption and integration of these technologies is recognizing where they can take the company and its products and then getting in on the development of the standards that define these technologies. Otherwise, adopting products and systems not developed solely for aerospace means kludges, patches, and lots of expensive customization. The successful company, the one with the competitive edge, is the one whose strategies include shifting standards development work to support its shift in products and processes.

Strategies for Developing, Managing, and Using Standards Must Continue to Evolve

The aerospace industry is about the future—it always has been and always will be. Our heritage has been to reach beyond our grasp—to the skies, to the moon, to the solar system, and beyond. And we've taken our standards with us. Technology has made these journeys possible. But standards help make them practicable. In order to support these technological advances and keep

our balance through all the changes, we've had to develop new standards and new ways of managing the business of standards.

The keys to strategically using standards to implement and manage change (as illustrated in the examples above) are simple to articulate, but often difficult to implement:

- Understand the changing requirements of your business
- Understand how standards can support these changes
- Utilize existing infrastructures whenever possible, but don't hesitate to change them if needed
- Understand teaming and alliances in the business world and understand the impact of partnerships on standards systems
- Search for the standards angle in everything that your company does. Don't let standards be an after-thought as you move to embrace new technologies, but incorporate standards as a key part of your company's business strategy.

The company that can successfully utilize and manage standards as it negotiates the range of changes needed to survive in today's global market will have a powerful tool for success.

The aerospace standardization system has always responded to new technical and managerial problems. Though standardization will probably never make front page news, those who have a stake in the future of the aerospace industry realize they cannot afford to be unaware of the standards system, the challenges it faces, and the key role standards play in ensuring our business continues to forever reach for new frontiers.

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